

WHAT IS CLAIMED IS:

1 1. A method of anchoring a balloon catheter in a patient, comprising the
2 steps of:

3 providing a balloon catheter having a shaft and a balloon mounted to
4 the shaft, the shaft having a distal end and a proximal end, the balloon having
5 an expanded shape and a collapsed shape, the expanded shape being
6 configured to occlude a body passageway in a patient, the balloon including
7 an outer surface having at least two high friction portion and at least two low
8 friction portions, the low friction portion having a lower coefficient of friction
9 than the at least two high friction portions relative to the patient's body
10 passageway, the balloon having at least three radially extending arms when
11 in the collapsed shape, each of the at least two low friction portions being
12 positioned at radially outward extremes of adjacent radially extending arms,
13 the high friction portion being exposed and positioned between the radially
14 outward extremes of the adjacent radially extending arms when the balloon is
15 in the collapsed shape, the high friction portion being everted when the
16 balloon moves from the collapsed shape to the expanded shape;

17 positioning the balloon in the patient's body passageway with the
18 balloon in the collapsed shape so that the radially outward extremes contact
19 the body passageway; and

20 advancing the balloon in the patient to a position to be occluded with
21 the balloon in the collapsed shape;

22 inflating the balloon after the advancing step so that the high friction
23 portion contacts the patient's body passageway for anchoring the balloon in
24 the patient's body passageway.

1 2. The method of claim 1, wherein:

2 the positioning step is carried out by inserting the balloon into the
3 patient's arterial system; and

4 the inflating step is carried out with the balloon being positioned in the
5 patient's ascending aorta.

- 1 3. The method of claim 1, wherein:
 - 2 the providing step is carried out with the balloon catheter having a first
 - 3 lumen and an opening at the distal end fluidly coupled to the first lumen, the
 - 4 opening being configured for delivery of a fluid into a patient,

- 1 4. The method of claim 3, further comprising the step of:
 - 2 introducing cardioplegic fluid into the patient through the first lumen.

- 1 5. The method of claim 1, wherein:
 - 2 the providing step is carried out with the balloon catheter having at
 - 3 least three arms extending radially outward from the shaft.

- 1 6. The method of claim 1, wherein:
 - 2 the providing step is carried out with the high friction portion having a
 - 3 plurality of ribs.

- 1 7. The method of claim 1, wherein:
 - 2 the providing step is carried out with the shaft having a substantially
 - 3 straight portion and a hooked portion connected to the substantially straight
 - 4 portion.

- 1 8. A balloon catheter for occluding a body passageway in a patient,
 - 2 comprising:
 - 3 a shaft; and
 - 4 a balloon mounted to the shaft, the balloon having an expanded shape
 - 5 and a collapsed shape, the expanded shape being configured to occlude a
 - 6 body passageway in a patient, the balloon including an outer surface having
 - 7 at least two high friction portions and a low friction portion, the low friction
 - 8 portion having a lower coefficient of friction than the high friction portions
 - 9 relative to the patient's body passageway, the balloon having at least three
 - 10 radially extending arms when in the collapsed shape, each of the at least two

11 low friction portions being positioned at radially outward extremes of
12 adjacent radially extending arms, the high friction portion being exposed and
13 being positioned between two of the radially outward extremes of the radially
14 extending arms when the balloon is in the collapsed shape, the high friction
15 portion being everted when the balloon moves from the collapsed shape to
16 the expanded shape.

1 9. The balloon catheter of claim 8, wherein:
2 the balloon is configured and sized to occlude the patient's ascending
3 aorta.

1 10. The balloon catheter of claim 8, wherein:
2 the shaft includes a first lumen and an opening at the distal end fluidly
3 coupled to the first lumen, the opening being configured for delivery of a
4 fluid into a patient.

1 11. The balloon catheter of claim 8, further comprising:
2 a source of cardioplegic fluid fluidly coupled to the first lumen.

1 12. The balloon catheter of claim 8, wherein:
2 the high friction portion includes a plurality of ribs.

1 13. The balloon catheter of claim 8, wherein:
2 the shaft has a substantially straight portion and a hooked portion
3 connected to the substantially straight portion.

1 14. A method for positioning a balloon in a passageway and occluding the
2 passageway, comprising the steps of:
3 providing a catheter having a shaft and a balloon mounted thereto, the
4 balloon having a collapsed shape and an expanded shape;
5 inserting the catheter into a body passageway of a patient with the
6 balloon in the collapsed shape;

- 7 positioning the catheter in a portion of the body passageway for
- 8 occluding the portion of the body passageway;
- 9 inflating the balloon with a fluid;
- 10 monitoring a rate of pressure increase in the balloon with respect to a
- 11 fluid volume in the balloon; and
- 12 adding an amount of fluid after the rate of pressure increase in the
- 13 balloon exceeds a predetermined threshold.

1 15. The method of claim 14, wherein:
2 the positioning step is carried out by positioning the balloon in the
3 patient's ascending aorta.

1 16. The method of claim 14, wherein:
2 the providing step is carried out with the catheter having a lumen
3 fluidly coupled to the balloon, the catheter also having a pressure sensor and
4 a pressure sensing alarm, the pressure sensing alarm indicating when the rate
5 of pressure increase in the balloon exceeds the predetermined threshold.

1 17. The method of claim 14, wherein:
2 the adding step is carried out with the amount of fluid being a
3 predetermined volume of fluid.

1 18. The method of claim 14, wherein:
2 the adding step is carried out by adding the amount of fluid to increase
3 the pressure in the balloon a predetermined amount.

1 19. A device for pressurizing a balloon catheter, comprising:
2 a catheter having a shaft and a balloon mounted thereto, the balloon
3 having a collapsed shape and an expanded shape, the collapsed shape being
4 configured for advancement within a patient the catheter having a first lumen
5 fluidly coupled to the balloon for inflating the balloon;

6 a fluid source coupled to the first lumen for inflating the balloon;
7 a pressure sensor configured to measure a pressure in an interior of the
8 balloon; and
9 a pressure monitor coupled to the pressure sensor, the pressure
10 monitor determining when a rate of pressure increase in the balloon with
11 respect to an increase in fluid volume in the balloon exceeds a predetermined
12 threshold.

1 20. The device of claim 19, further comprising:
2 means for adding a predetermined amount of fluid after the pressure
3 monitor detects the rate of pressure increase exceeds the predetermined
4 threshold.

1 21. The device of claim 19, further comprising:
2 means for increasing the pressure in the balloon a predetermined
3 amount after the pressure monitor detects the rate of pressure increase
4 exceeds the predetermined threshold.

1 22. A method of anchoring an occluding member in a patient, comprising
2 the steps of:
3 inserting a catheter having an occluding member mounted thereto, the
4 occluding member having a collapsed shape and an expanded shape;
5 positioning the occluding member in a body passageway in the patient;
6 expanding the occluding member to the expanded shape after the
7 positioning step to thereby occlude the body passageway;
8 monitoring a pressure exerted on the occluding member on a distal
9 side and a proximal side of the occluding member; and
10 determining a difference between the pressure on the distal and
11 proximal sides of the occluding member.

1 23. The method of claim 22, further comprising the step of:

2 adjusting a pressure on at least one of the distal and proximal sides of
3 the occluding member.

1 24. The method of claim 22, wherein:
2 the adjusting step is carried out by adjusting a pressure on the distal
3 side of the occluding member.

1 25. The method of claim 22, wherein:
2 the inserting step is carried out with the occluding member being a
3 balloon.

1 26. The method of claim 22, wherein:
2 the inserting step is carried out with the body passageway being an
3 ascending aorta.

1 27. A catheter for occluding an ascending aorta in a patient, comprising:
2 a shaft having a distal end and a proximal end;
3 an occluding member mounted to the shaft, the occluding member
4 having an expanded shape sized to occlude the patient's ascending aorta;
5 a first pressure sensor positioned between the distal end and the
6 occluding member for measuring a pressure on a first side of the occluding
7 member; and
8 a second pressure sensor positioned between the proximal end and the
9 occluding member for measuring a pressure on a second side of the occluding
10 member.

1 28. The catheter of claim 27, further comprising:
2 a pressure monitor coupled to the first and second pressure sensors,
3 the pressure monitor determining a pressure difference between the first and
4 second pressure sensors.

1 29. The catheter of claim 28, further comprising:
2 an alarm coupled to the pressure monitor for indicating when a
3 pressure difference sensed by the first and second pressure sensors exceeds a
4 predetermined threshold.

1 30. The catheter of claim 27, wherein:
2 the occluding member is a balloon; and
3 the shaft includes a first lumen, a second lumen and an opening at the
4 distal end of the shaft fluidly coupled to the first lumen, the second lumen
5 being fluidly coupled to the balloon for inflating the balloon.

1 31. The catheter of claim 30, further comprising:
2 means for adjusting the pressure on at least one of the first and second
3 sides of the balloon when a pressure difference sensed by the first and second
4 pressure sensors exceeds a predetermined threshold, the pressure adjusting
5 means reducing the pressure difference to a value below the predetermined
6 threshold.

1 32. The catheter of claim 31, wherein:
2 the pressure adjusting means is coupled to the first lumen for adjusting
3 a fluid pressure exerted by fluid delivered into the ascending aorta through
4 the first lumen.

1 33. A method of anchoring an occluding member in an ascending aorta of
2 a patient, comprising the steps of:
3 inserting a catheter into a patient, the catheter including a shaft having
4 an occluding member at a distal end, the occluding member having a
5 collapsed shape and an expanded shape;
6 positioning the catheter in the patient's ascending aorta;
7 expanding the occluding member to the expanded shape after the
8 positioning step to thereby occlude the ascending aorta; and

9 displacing the shaft of the catheter a first amount after the expanding
10 step so that a predetermined portion of the catheter contacts the patient's
11 aortic lumen for anchoring the occluding member in the ascending aorta.

1 34. The method of claim 33, wherein:
2 the displacing step is carried out by withdrawing an amount of the
3 catheter from the patient so that the predetermined portion of the catheter
4 engages a radially inner portion of the patient's ascending aorta.

1 35. The method of claim 33, further comprising the step of:
2 displacing the catheter a second amount in a direction opposite to the
3 first amount so that a second predetermined portion of the shaft engages a
4 radially outer wall of the patient's ascending aorta.

1 36. The method of claim 33, further comprising the step of:
2 inserting the shaft through a delivery cannula, the delivery cannula
3 having a shaft engaging mechanism and a shaft displacing mechanism;
4 the displacing step being performed with the shaft displacing
5 mechanism of the delivery cannula.

1 37. A catheter having an expandable member for occluding an ascending
2 aorta in a patient, comprising:
3 a shaft having a longitudinal axis, a distal end, a proximal end, a first
4 lumen and an opening at the distal end in fluid communication with the
5 opening, the opening being configured for delivery of a fluid into the
6 patient's ascending aorta;
7 an expandable member mounted near the distal end of the shaft, the
8 expandable member having an expanded shape and a collapsed shape, the
9 expanded shape being configured to occlude the patient's ascending aorta;
10 and

11 a delivery cannula, the shaft being movably coupled to the delivery
12 cannula for movement in a direction parallel to the longitudinal axis in an
13 inward direction and an outward direction;
14 the shaft having a first portion configured to contact the radially inner
15 wall of the aortic lumen when the shaft is slidably displaced in the outward
16 direction.

1 38. The catheter of claim 37, further comprising:
2 a shaft displacing mechanism coupled to the delivery cannula, the shaft
3 displacing mechanism being configured to displace the shaft a predetermined
4 amount in the outward direction so that the first portion engages the radially
5 inner wall of the aortic lumen.

1 39. The catheter of claim 37, wherein:
2 the shaft includes a second portion configured to contact a radially
3 outer wall of the aortic lumen when the shaft is slidably displaced in the
4 inward direction.

1 40. The catheter of claim 39, wherein:
2 the shaft includes a third portion configured to contact the radially
3 outer wall of the aortic lumen when the shaft is slidably displaced in the
4 inward direction, the second portion being positioned between the first and
5 second portions.

1 41. The catheter of claim 37, wherein:
2 the delivery cannula includes a lumen for introducing a fluid into the
3 patient.

1 42. The catheter of claim 37, wherein:
2 the shaft includes a first bend and a second bend, the first portion
3 being positioned between the first and second bends.

1 43. A method of anchoring an occluding member in a patient comprising
2 the steps of:

3 inserting a catheter into a patient, the catheter having an occluding
4 member mounted thereto;
5 positioning the occluding member at a desired location;
6 expanding the occluding member to occlude the desired location; and
7 clamping a portion of the passageway adjacent the desired location to
8 prevent migration of the occluding member.

1 44. The method of claim 43, wherein:

2 the inserting step is carried out with the occluding member being a
3 balloon.

1 45. The method of claim 43, wherein:

2 the clamping step is carried out by clamping the body passageway
3 around the balloon thereby trapping the balloon.

1 46. The method of claim 43, wherein:

2 the inserting step is carried out with the balloon having an indentation;
3 and

4 the clamping step is carried out with the clamp being positioned
5 around the indentation.

1 47. A method of anchoring an occluding member in a patient's ascending
2 aorta comprising the steps of:

3 inserting an occluding member in the ascending aorta between the
4 coronary ostia and the brachiocephalic artery;
5 expanding the occluding member in the patient after the inserting step;
6 positioning an anchor in the brachiocephalic artery, the anchor having
7 a proximal end extending into the aorta, the anchor preventing migration of
8 the occluding member beyond the brachiocephalic artery.

1 48. The method of claim 47, wherein:
2 the positioning step is carried out with the anchor being a perfusion
3 catheter configured to deliver oxygenated blood to the brachiocephalic artery.

1 49. The method of claim 47, wherein:
2 the anchor is separate from the catheter.